trials; thus in his examples he works to seven places of decimals, and we have not noticed a case in which more than seven trials are required. The one, unfortunately fatal, objection, is that he has ignored the conditions of the problem; it is as though the value of π were found from the perimeter of a regular polygon of 2^n sides. By taking n large enough, we can get by Euclidean construction a value as near π as we please; but it is needless to say that this is not what is meant by "squaring the circle" with rule and compass.

Dr. Whiteford's method is sufficiently ingenious to deserve a brief description. Let AP be an arc of a circle, of which AOB, COD are perpendicular diameters; then if through P a line PQRS be drawn cutting the circle in R, and the diameters CD, AB in Q, S, so that QS=AB, then the angle ROB is one-third of the angle AOP. This theorem was known to the Greeks, and, in fact, led to the invention of the conchoid of Nicomedes as an auxiliary curve for the trisection of the angle. If we take Q anywhere on CD and produce PQ to S, making QS=AB, the locus of S is a conchoid, and its intersection with AB gives the solution of the problem. Now Dr. Whiteford gives a construction for a point on AB, which is in no case very far from S, and thence obtains a sequence of points which have S for their limiting point. After translating his construction into trigonometry, he gives fifty-one worked-out examples, so variously distributed over the quadrant as to leave no doubt that his sequence does actually converge in every case, though, as might be expected, he makes no attempt to prove this fact.

It is easy to draw the obvious moral that it is waste of time to attack a mathematical problem without completely understanding what the problem is. However, this is perhaps ungracious; let us rather conclude by admitting that Dr. Whiteford has added one more to the fairly numerous approximate solutions of this celebrated problem. G. B. M.

LILIENTHAL'S WORK ON AVIATION.

Birdflight as the Basis of Aviation: a Contribution towards a System of Aviation, Compiled from the Results of Numerous Experiments made by O. and G. Lilienthal. By Otto Lilienthal. With a biographical introduction and addendum by Gustav Lilienthal. Translated from the second edition by A. W. Isenthal. Pp. xxiv+142+viii plates. (London: Longmans, Green, and Co., 1911.) Price 9*s.* net.

THE interest of this book lies chiefly in the biographical part. The two Lilienthals, born in the town of Anklam, were from childhood devoted to mechanics, and also to natural history. Otto gained practical knowledge as a mechanic in the works of Schuarlzkopf in Berlin, while his brother was educated as an architect. Watching the flight of the storks which abounded about their home seems to have given them their first taste for the problems which afterwards occupied so much of their attention.

One curious passage (p. 103) is here quoted. After a picturesque description of the storks following the harvesters to pick up field mice and such "small deer," and a reference to the high regard in which the birds are held by the farmers, we read:—

"Thus it is not to be wondered at if the farmers, above whose homesteads these birds with a span of two metres hold great flight meetings every year, evince great interest in the art of flight, though they do not wish it to be known, fearing ridicule. Nevertheless, from no other trade or profession have so many inquiries for light engines—for a secret purpose—reached the author, as from farmers."

The theoretical part of the book is not of any great value, and some of the diagrams (notably those on pp. 45 and 56, of the flow of a stream past an obstacle) are very far from representing the actual facts.

Lilienthal seems to have attached great importance to curved, as against plane, and flapping, as against fixed wings. Flapping wings are really the more efficient of the two, but not for the reasons given.

Difficulties of mechanical construction have hitherto prevented their adequate trial on a large scale, but it would be too much to say that they are impracticable.

The merit of the curved wing section now generally in use is not that it gives an increased lift or efficiency, but that the efficiency does not vary so rapidly with the change of inclination to the air current as happens when the surfaces are planes.

It is seldom that the enthusiasm, mechanical ability, knowledge, and money necessary for experiments in a new field are found in the possession of one and the same individual. Lilienthal had the two first, but was hampered as regards the others. This book, however, which is well translated, should be read as giving a very interesting account of the work of a typical "inventor" of the best class.

A. MALLOCK.

OUR BOOK SHELF.

A Systematic Handbook of Volumetric Analysis; or, the Quantitative Determination of Chemical Substances by Measure, Applied to Liquids, Solids, and Gases. By F. Sutton. Tenth edition. Revised throughout, with numerous additions, by W. L. Sutton and A. E. Johnson. Pp. xiv+621. (London: J. and A. Churchill, 1911.) Price 21*s.* net.

A BOOK that has been the standard text-book on its subject for nearly fifty years, and continues to enjoy that position, calls for little remark as edition after edition is issued. Every student of chemistry knows, or ought to know, his "Sutton," as he knows his "Fresenius," and it would therefore be superfluous to attempt to describe its character and scope. The author, being now eighty years old, has placed the preparation of this tenth edition entirely in the hands of the two editors named in the title. There seems to be every evidence that the editors have done their work thoroughly and judiciously. They say that a good deal of obsolete matter has been deleted, and we naturally turned to some of those classical methods that have served so well in the past, such as Bunsen's method of gas analysis, and have been almost wholly replaced, rather than superseded, by processes that are more suitable for technical work. But the

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old method of making and graduating, as well as calibrating, gas burettes is retained, though the apparatus for graduating and etching them would probably be regarded as curiosities in a modern laboratory.

By means of a new setting, and a rather smaller though quite clear type for some paragraphs and sections, space has been economised, and the volume, with all its added matter, is practically of the same size as the last edition. The deletions have in no sense altered the character of the book as giving full practical instructions, but in some cases, where a suggested modification is of comparatively little importance, or an application of a process is of very restricted use, the editors give only a short statement and refer to the original description by the author. In many cases they have taken advantage of the assistance of experts who have had exceptional experience of various methods. All factors and numerical details have been recalculated according to the latest "International Atomic Weights." The section on weights and measures has been rewritten, using the data adopted at the National Physical Laboratory.

In short, the editors appear to have spared no trouble to maintain if they could not enhance the reputation of the book, and thus to merit the gratitude that the aged author expresses in his preface, and, we may add, the thanks of all those who are interested in the subject with which it deals.

The Influence of Strong, Prevalent, Rain-bearing Winds on the Prevalence of Phthisis. By Dr. W. Gordon. Pp. xiv+108. (London: H. K. Lewis, 1910.) Price 7*s.* 6*d.* net.

FOR many years Dr. Gordon, in a series of papers, has brought before the medical profession evidence that strong rain-bearing winds have a very definite influence on the prevalence of phthisis. He has now collected these papers, and, in a work bearing the above title, gives a complete account of his observations. He maintains, as a result of these observations, that in any situation exposed to rain-bearing winds, whether it be over a wide region or merely the side of a street, the mortality from pulmonary phthisis is high. He works this out specially for Devonshire, but takes Exeter streets at one extreme and the civilised world at the other, always coming to the same conclusion. In all this, however, he does not, by any means, ignore other factors, especially "soil" and poverty. Our author points out that this high mortality from consumption is not due merely to a depression of vitality, for it is found that the general death-rate is not affected in the same way as is the phthisical death-rate. Moreover, he is satisfied that the action of the rain-bearing wind is exerted directly on the person exposed to it and not indirectly, "either through closure of doors and windows against the wind or by it driving wet into the walls of the houses."

It is, of course, difficult to test the accuracy of Dr. Gordon's observations, but his figures certainly seem to prove that, taking female death-rates as offering a safer basis of inquiry, in the rural districts of Devonshire, swept by rain-laden winds, the mortality is higher than in those where the winds are dry. Dr. Gordon, not shirking the numerous criticisms that have been directed against his conclusions, has certainly made out a very strong case for the accuracy of his hypothesis. As dealing with one of the side-issues of the tuberculosis question, as opening up a new field of inquiry, and as affording a guide to those in search of places to which consumptives may be sent, although it is not designed for that special purpose, this work will be of very considerable value. The coloured charts on which the statistics are both based and recorded are exquisitely drawn and reproduced. We congratulate Dr. Gordon on the completeness of his work.

Die Naturwissenschaften in ihrer Entwicklung und in ihrem Zusammenhange. By Friedrich Dannemann. Erster Band, Von den Aufängen bis zum Wiederaufleben der Wissenschaften. Pp. viii+374. Leipzig: Wilhelm Engelmann, 1910.) Price 9 marks.

THIS is the first of four volumes designed to give a connected history of the development of all the sciences, with especial regard to their connection with each other. It deals with the earliest records of geometrical and arithmetical learning among the Egyptians and the Sumerian conquerors of Mesopotamia; proceeds to the Greeks from Thales to Aristotle; sketches the development of science in the Greek colonies, the two periods of Alexandrian learning, the Arabian era, and the decline of the Middle Ages; and finally describes the revival of learning in the fifteenth century.

In dealing with Babylon, the author makes some telling extracts from the Nippur tablets, which date back to between 2200 and 1350 B.C., to show that a decimal system of notation is used in the cuneiform inscriptions, without, however, the use of the zero circle, which was introduced by the Indians, and brought to Europe by the Arabs.

In a work like this one misses a description of the Egyptian orientations of temples and pyramids with regard to particular stars. The recent Cretan discoveries are not included, and Chinese observations are only briefly touched upon. But the book is written in a very entertaining style, and as it is plentifully supplied with references, it forms a useful guide-book through the historic development of the sciences.

A Course of Plane Geometry for Advanced Students. Part II. By C. V. Durell. Pp. xiv+358. (London: Macmillan and Co., Ltd., 1910.) Price 7*s.* 6*d.* net.

THE first part of this work, on the straight line and circle, has already been reviewed. The present volume, which treats of conics, shows the same merits of clearness, conciseness, and good judgment. For example, there is a fairly complete account of involution, which is by far the most powerful instrument for developing the properties of conics; and, in order to avoid, on one hand, a lack of rigour, and on the other a difficult theory, the author has frankly based his treatment on an algebraic foundation. Other chapters deal with homography in general, reciprocation and projection; there is even a brief outline of practical solid geometry, though this is too sketchy to be of much use. There are various historical notes, excellent diagrams, and a vast collection of exercises; altogether Mr. Durell's book may be recommended as a trustworthy, practical, and interesting text-book.

M.

The Phase Rule and its Applications. By Dr. Alex. Findlay. Third edition. Pp. xvi+356. (London: Longmans, Green, and Co., 1911.) Price 6*s.*

THE first edition of Dr. Findlay's book was reviewed in these columns on April 21, 1904 (vol lxix., p. 579), and the arrangement and general character of the work remain much the same as they were. In the second edition numerous additions were made to bring the information up to date, and though no changes of a fundamental nature have been made in the present edition, paragraphs have been added where necessary on the results of recent researches. In addition to this, the whole book has been subjected to careful revision.

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